

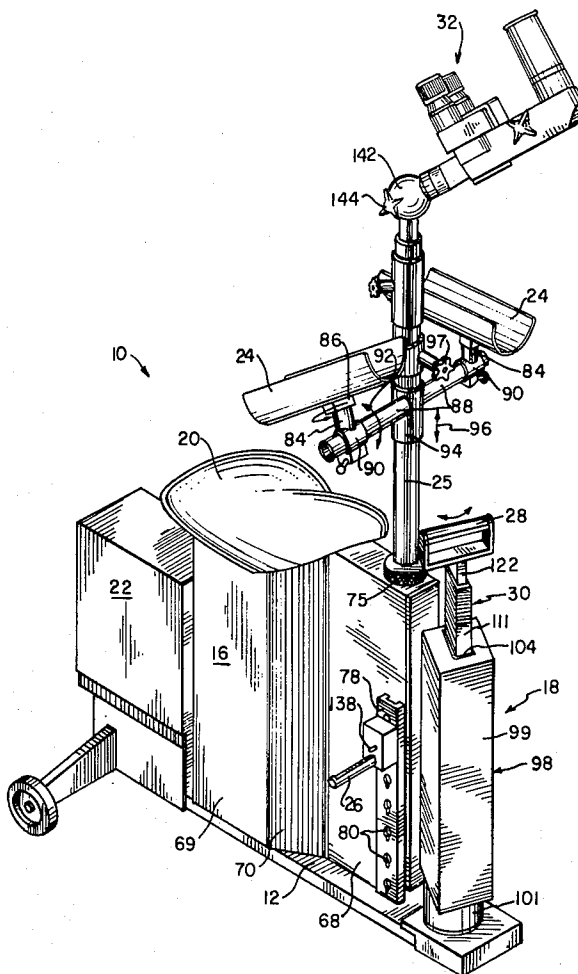


FIG. 1

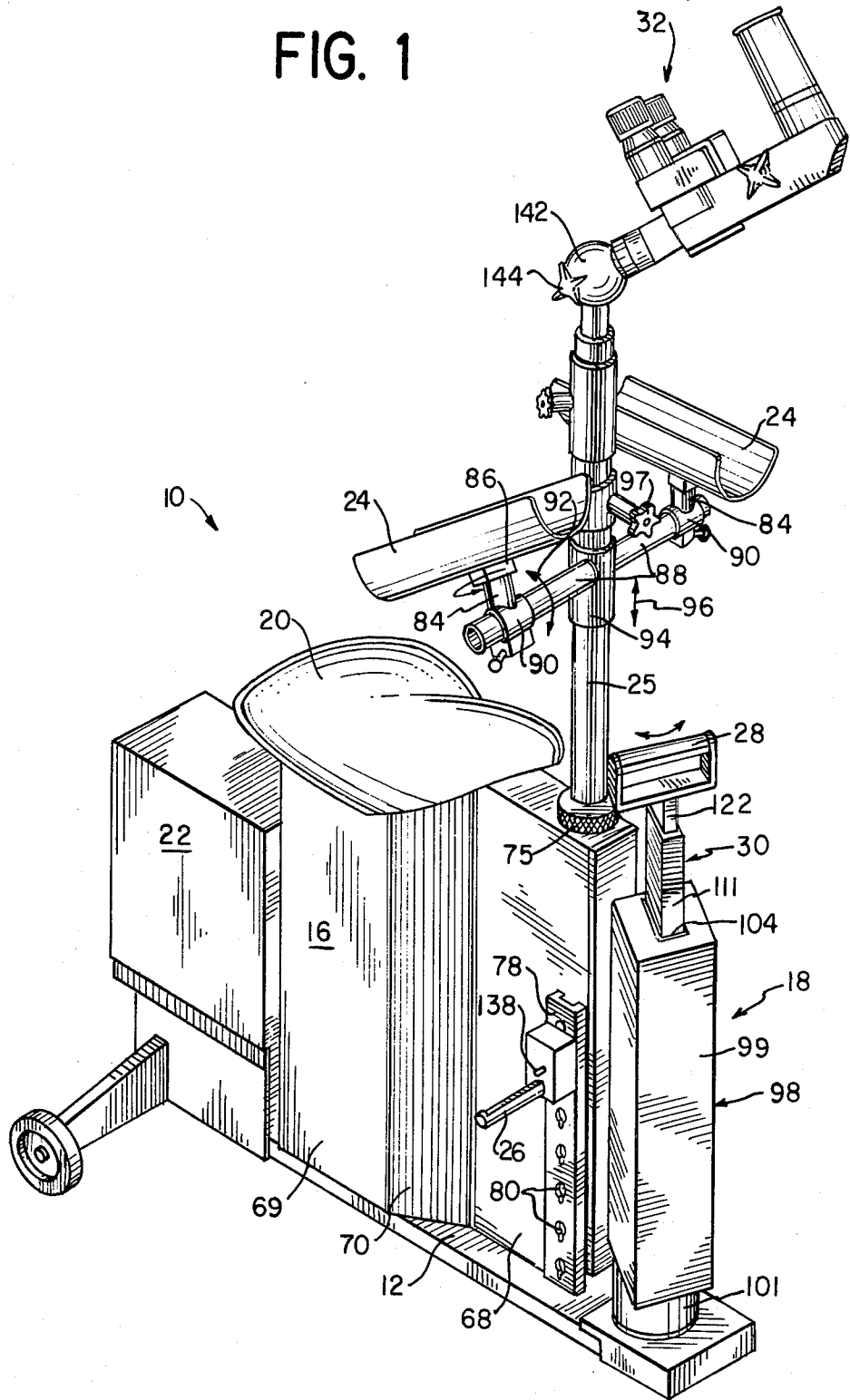


FIG. 2

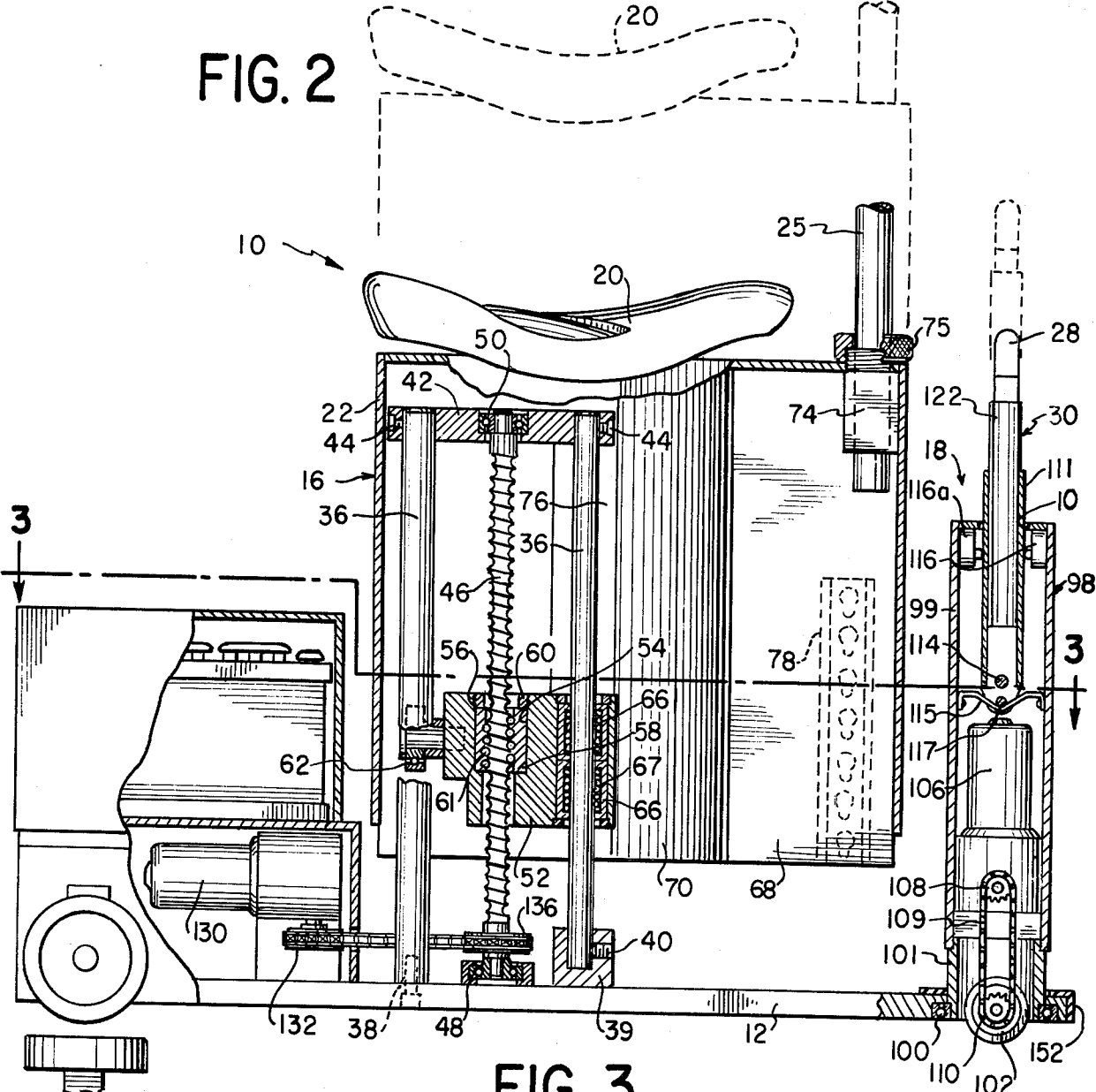
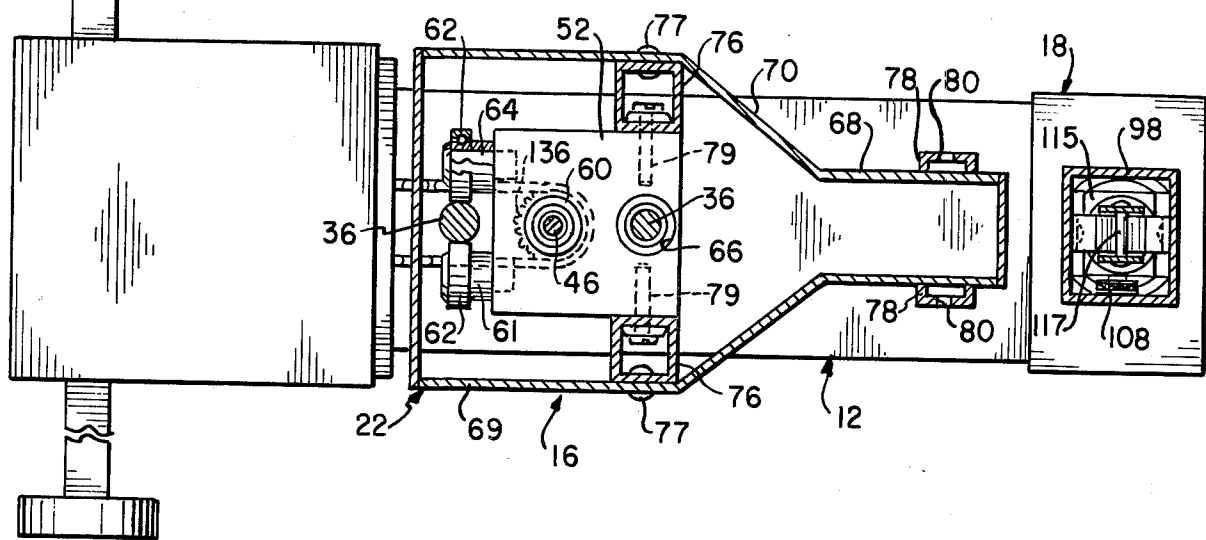


FIG. 3



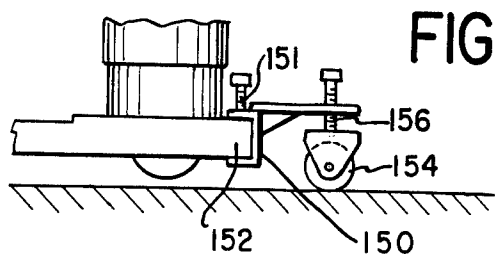


FIG. 6

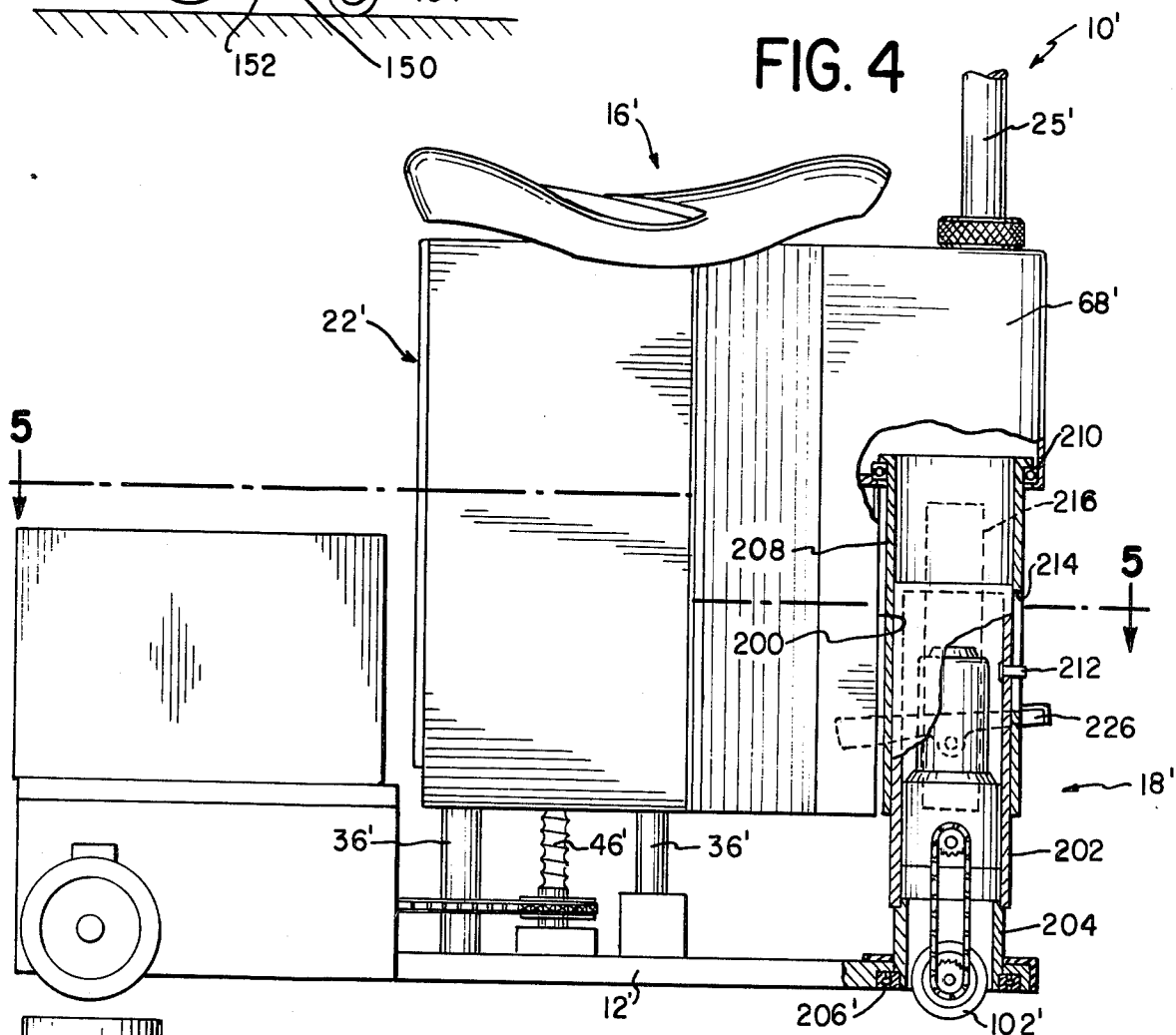


FIG. 4

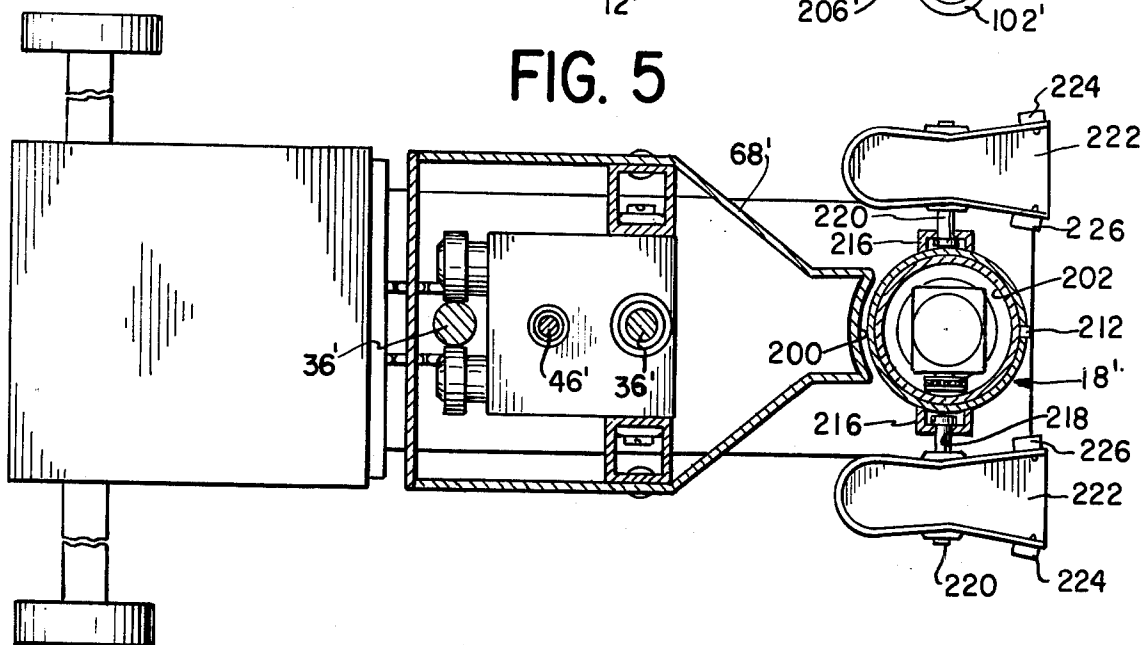


FIG. 5

SURGICAL SUPPORT

BACKGROUND OF THE INVENTION

This invention relates generally to surgical supports and, more particularly, to an adjustable support for a surgeon to facilitate comfort and steadiness during a surgical operation.

It is not unusual for certain surgical operations to require many hours for their completion. As more complex surgical procedures are developed, the duration of operations have increased. During the course of such surgery, the surgeon, who normally assumes a standing position adjacent the operating table, inevitably becomes somewhat fatigued.

For example, open heart surgery in particular is a procedure which is necessarily of lengthy duration. Rendering such surgery even more tedious is the fact that micro-surgical techniques which inherently involve the surgeon executing extremely delicate manual manipulations are often necessary. As the duration of the operation increases, the ability of the surgeon to precisely manipulate his instruments correspondingly decreases. Even during microsurgery of relatively short duration, unavoidable involuntary body movements of the surgeon contribute to the difficulty of precisely manipulating the surgical instruments especially when the area is viewed under the magnification of a microscope. In fact, these problems are encountered during macro-surgery as well as microsurgery.

In the past, surgeons have sought to alleviate these problems by resting their arms either on the side of the operating table, on some other convenient fixed object, or on the patient himself. This of course is not efficient in that an adequate supporting structure may not always be available in the operating room. Recently, however, there have been attempts to provide operating supports for surgeons. Such supports are exemplified in U.S. Pat. Nos. 3,557,791 and 3,754,787 issued Jan. 26, 1971 and Aug. 28, 1973, respectively. While these devices have at least shown recognition of the problems described above, they do not provide the most practical answers. For example, the device shown in U.S. Pat. No. 3,754,787 is not mobile and cannot, among other things, be precisely repositioned by the surgeon during the operation to relocate himself at a more convenient location adjacent the operating table. All of the supporting surfaces of the device illustrated in U.S. Pat. No. 3,557,791 are not adjustable either individually or as a unit. Further, specific apparatus for automatically controlling the relative position of the supporting surfaces with respect to each other as well as specific means for moving the structure as a unit are not disclosed.

SUMMARY OF THE INVENTION

Accordingly, one object of the present invention is to provide a new and improved operating support for a surgeon for use during surgical operations.

Another object of the present invention is to provide a new and improved operating support for a surgeon having various supporting surfaces which are adjustable both individually and as a unit.

Still another object of the present invention is to provide a new and improved operating support for surgeons which can be self-propelled in any desired direction.

A further object of the instant invention is to provide a supporting structure for surgeons on which at least one optical device may be mounted whose position is both individually adjustable and adjustable as a unit together with the supporting structures.

Briefly, in accordance with the present invention, these and other objects are attained by providing a body support whose height relative to the ground is automatically adjustable to one of a plurality of positions by the surgeon supported thereon. Arm and leg supports are also provided in a similarly adjustable manner. The body, arm and leg supports are adapted to be individually positionable relative to each other and/or positionable as a unit in the vertical direction relative to the ground. A self-contained power source is provided which together with steering apparatus, enables the surgical support to be maneuvered by the surgeon toward or away from the operating table during the operation.

DESCRIPTION OF THE DRAWINGS

A more complete description of the invention and many of the attendant advantages thereof will be readily appreciated by reference to the following detailed description when considered in connection with the accompanying drawings, in which:

FIG. 1 is a perspective view of the surgical support according to the present invention;

FIG. 2 is an elevation view in partial section of the surgical support according to the present invention; and

FIG. 3 is a plan view taken in section along line 3—3 of FIG. 2.

FIG. 4 is an elevation view in partial section of another embodiment of the surgical support according to the present invention;

FIG. 5 is a section view taken along line 5—5 of FIG. 4;

FIG. 6 is a front view of a transport accessory for use with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings where like reference numerals designate identical or corresponding parts throughout the several views and more particularly to FIG. 1, the surgical support generally denoted as 10, includes a supporting frame 12 which is itself supported on a tricycle wheel arrangement (FIGS. 2 and 3). A power source is contained within a housing 14 mounted at the rear of frame 12 while a drive mechanism 18 is mounted at the forward end of frame 12 and a body and limb supporting mechanism 16 is mounted between the housing and drive mechanism. The term "body and limb supporting mechanism 16" (hereinafter support mechanism 16) includes all support structure (for example, arm, leg and seat) and the apparatus to which this structure is mounted.

A brief description of the operation of the surgical support 10 will enable a clearer and more precise description of the structure of the same. The physician seats himself on a saddle 20 fixed to the top of a fairing 22 which encloses the various mechanical elements which are associated with the body and limb supporting mechanism 16 (hereinafter referred to as support mechanism 16). The physician then positions his forearms in respective ones of a pair of arm supports 24

mounted on a support column 25 and his feet on respective ones of a pair of foot supports 26. In order to comfortably accommodate physicians of all physical sizes, the relative positions of the saddle 20, arm rests 24 and foot rests 26 are all adjustable individually with respect to each other in a manner described in detail hereinbelow. After the relative positions of the supports have been set by the physician, preferably prior to commencement of the operation, the entire supporting mechanism 16 which includes saddle 20, arm rests 24, and foot rests 26 may then be automatically raised or lowered as a unit in order to position the physician in the most advantageous location relative to the operating table. This may be done during the operation itself. The surgeon may steer the entire surgical support 10 toward or away from or to a new position adjacent to the operating table through the manipulation of drive mechanism 18, i.e., by pulling back or pushing forward on a yoke 28 fastened to a control bar 30. When the support 10 is used for specialized applications such as microsurgery, optical devices such as a microscope 32 (and other suitable devices such, for example, as a television camera, still camera or movie camera and the like) may be fastened to the support mechanism 16.

Referring now to FIGS. 2 and 3 the support mechanism 16 will now be described in greater detail. A pair of spaced cylindrical rods, conveniently denoted as tracking rod 34 and guide rod 36, are vertically mounted on frame 12, with their lower ends connected thereto by a conventional bolt 38 and a mounting block 39 having a set screw 40, respectively. The upper ends of rods 34 and 36 are received within cylindrical openings formed in a plate 42. These rods support plate 42 and are held fast in the openings by conventional fasteners such as by bolts 44.

An elongated ball screw 46, that is, a shaft having a helical ball race, is vertically mounted between rods 34 and 36. The lower and upper ends of the screw 46 are respectively mounted in a ball bearing 48 fixed to frame 12 and a bearing 50 mounted within plate 42. This permits the screw 46 to rotate about its longitudinal axis. Screw 46 passes through a carriage 52 having a stepped diameter bore 54. A ball nut element 56, that is, a bushing whose inner surface has a helical ball race formed in it, is captured between a shoulder 58 of bore 54 and a threaded collar 60. A plurality of balls 61 are captured within ball nut 56 and cooperate with the respective races formed in the screw and nut. Thus, when screw 46 is rotated, carriage 52 is either raised or lowered depending upon the direction of rotation. A bearing 62 is mounted on each of a pair of stub shafts 64 which extend from the rear of the carriage on each side of rod 34. The outer rim of each bearing 62 cooperates with the surface of the tracking rod 34 (FIG. 3) thereby maintaining the carriage angularly fixed relative to the support mechanism 16.

A pair of ball bushings 66 are retained within a bore 67 formed in the forward end of carriage 52. These receive guide rod 36 and reduce the friction between the carriage and the guide rod during movement of the former over the latter. The combined action of the tracking rod 34, guide rod 36 and screw 46 serve to insure that the carriage moves freely upon rotation of the screw without binding or jamming.

Fairing 22 is a sheet metal piece suitably formed to provide a wider rear portion 69 connected to a forward

narrower portion 68 by a tapered middle portion 70 (FIG. 3). Saddle 20 is supported on both the rear and middle portions 69 and 70 of the fairing, this placement affording sufficient stability and strength. The particular shape of fairing 22 provides space for the legs of the physician when he is seated in saddle 20.

A pair of hollow columns 76 (FIG. 3) are rigidly fastened to opposed inner surfaces of fairing 22 by rivets 77. These columns provide structural rigidity for the support mechanism 16 by reinforcing the sides of the fairing since it must withstand the weight of the physician. Additionally, the columns 76 indirectly connect carriage 52 to the support mechanism 16. This is accomplished by rigidly connecting the lateral sides of carriage 52 to the columns 76 as by bolts 79 so that as the carriage is raised and lowered it moves the columns and therefore the entire support mechanism 16 along with it.

A pair of channels 78 are vertically mounted on opposed outer surfaces of the forward portion 68 of fairing 22. Each channel has a plurality of key slots 80 formed in it spaced along its longitudinal axis at different heights relative to frame 12. These slots are adapted to be coupled to tangs (not shown) which are part of foot supports 26. Thus, each foot support 26 may be positioned in any desired one of the slots 80 according to the preference of the physician.

A support column 25 extends vertically from the forward portion of fairing 22. The lower end of column 25 is received within a bushing 74 fastened to the fairing as by welding. A locknut 75 is provided to frictionally lock the column in place. This arrangement allows the support column to be removed from the apparatus if so desired. Each arm support 24 (FIG. 1) comprises a trough-shaped channel universally positionable via a ball-socket coupling 86 on a short arm 84. Each arm 84 terminates in an adjustable cylindrical collar 90 which is received over the end of a longer tubular arm 88. The collar 90 may be loosened and re-tightened on arm 88 in order to selectively position arm support 24 relative to arm 88 in the direction of arrow 92. The other end of each arm 88 is affixed to a second collar 94 which is slidably mounted over column 25 and selectively positionable at any point along its length in the direction of arrow 96 by turning a knob 97 which loosens or tightens collar 94. Thus, by suitably rotating and sliding the above-identified collar elements 84, 90, and 94, each arm support 24 is positionable in one of a plurality of positions so as to accommodate a physician of any physical size in any particular situation. Of course, if the physician desires that the arm support move upon the application of sufficient pressure the appropriate collar element may be so adjusted as by not tightening it to its maximum extent. Thus, while the physician's forearm may be constrained at a particular height, he may, if desired, be free to rotate the arm support in any desired oblique plane.

Turning now to FIGS. 2 and 3 the drive mechanism 18 of the present invention will now be described. A housing 98 at the forward end of the frame has an upper tubular portion 99 with a square cross section. This is rigidly connected to a lower cylindrical portion 101 which in turn is rotatably mounted at its lower end in the forward end of frame 12 within a bearing 100. A wheel 102 which serves as the steering wheel for the surgical support is mounted within housing 98 and partially extends through an opening in the frame to bear

against the ground. The top of the upper portion 99 of housing 98 extends to the approximate height of the fairing 22 when the latter is in its lowermost position as shown in FIG. 1.

Housing 98 contains a reversible electric motor 106 which drives a first sprocket 108. Sprocket 108 is coupled by a chain 109 to a second sprocket 110 which is fixed to the drive shaft on which wheel 102 is mounted. A rectangular tube 111 comprises control bar 30 which extends into housing 98 through an opening 104 formed in its upper end and is pivotally mounted to the housing by a pin 114. A flexible sheet metal band 115 has its ends fixed to opposed sides of housing 99 and extends across its interior. A depression is formed in the band. As control bar 30 is pivoted about pin 114, pin 117 is urged against a side of the flexible band 115 which thereby tends to urge the bar back to its vertical position.

A pair of microswitches 116, 116a are mounted opposite each other on the upper ends of opposed walls of housing 98. As seen in FIG. 2, when tube 111 is in a vertical position, it is located precisely midway between the microswitches 116, 116a not closing either. When tube 111 is drawn back it will close switch 116a which is adapted to activate motor 106 to drive wheel 102 backward causing the support 10 to move backwards. When tube 111 is moved forward, microswitch 116 is closed thereby causing wheel 102 to rotate forward and to now move the surgical support in the forward direction. Since the physician may raise the support mechanism 16 to an elevated position as shown in FIG. 2, a tube 122 is provided in telescoping relationship with tube 111 and a yoke 28 (FIG. 1) is fixed at the top end of tube 122. Thus control bar 30 may be extended vertically as shown in phantom in FIG. 2 so that the surgeon may easily reach it. In order to steer the surgical support, the yoke need only be turned in the direction of arrow 124 (FIG. 1) which causes housing 98 together with wheel 102 to rotate in bearing 100.

The particular design of the drive mechanism is advantageous in that it allows the movement of the surgical support 10 toward or away from or to a new position relative to the operating table with a minimum of inconvenience. It is often necessary for a surgeon to relocate himself during an operation. If he is using extraneous supports for his arms this relocation entails an awkward movement of these supports to the surgeon's new location. The present device enables the surgeon to accomplish simple and quick change of position together with the supports without his ever leaving his seat.

Referring to FIG. 2 a housing 14 at the rear end of the frame 12 houses a storage battery which powers both the reversible motor 106 and a second reversible motor 130 which drives a sprocket 132 on its output shaft. A chain drive connects sprocket 132 to another sprocket 136 fixed to screw 46. A microswitch 138 is provided on the inner end of each foot support 26 (only one shown) flush against channel 78. Each microswitch is electrically connected to motor 130 and, when closed, causes the motor 130 to rotate sprocket 132 in a particular direction. The physician closes a selected microswitch by pushing it with his respective foot. Upon closing one of the microswitches, motor 130 is activated in one direction or the other causing screw 46 to rotate in a particular direction. For example, if the right foot activates its associated microswitch, screw 46

is rotated to cause carriage 52 to move up. This causes the support mechanism 16 including the limb supports, seat and column 25 along with it to be elevated. Correspondingly, when the left microswitch is closed the motor 130 is rotated in the opposite direction causing the support mechanism to descend. Thus, the physician may raise or lower all supporting surfaces as a unit automatically when desired. It should be noted that all of the electrical circuitry involved in this invention is deemed to be conventional and, accordingly, is not shown for the sake of clarity.

The storage battery may also provide the power for other equipment needed during an operation. For example, during brain surgery, a vacuum line of relatively low vacuum (that is, not too far below atmospheric pressure) is needed to drain fluids from the cranial area. The battery may power a pump mounted on the surgical support to provide a completely self-contained vacuum system.

As seen in FIG. 1, the microscope 32 is mounted on a conventional universal ball-socket swivel adjustment 142 at the top of column 25 and may be loosened or removed by merely rotating wheel 144. It should be noted that the design of the supporting structure for the optical instruments provides that upon raising the support mechanism 16, the optical device is also raised. This is advantageous since the surgeon may adjust his vertical position several times during the course of an operation without having to readjust the position of the optical device.

Thus, it is seen that the subject invention provides a surgical support whereby a physician may adjust the height of the seat, the individual arm supports and foot supports independently of each other. Additionally, all the elements may be elevated as a unit relative to the ground. The particular design of the supports provides the additional advantage of adjustability both individually and as a unit while preserving sterility during the operation. Typically, the supports are draped under a sterile plastic skirt in order to prevent contamination of the area proximate to the patient. According to the design of the invention, all the supporting surfaces of the support 10 may be moved both individually and as a unit without removing the sheet so that sterility is not broken. Specifically, microswitches 138 may be closed to raise and lower the supporting surfaces as a unit while the position of the arm supports may be changed without lifting the protective sheet.

In those situations where it is desirable for the surgeon to be located immediately adjacent to the operating table, the surgical support 10 shown in FIGS. 1-3 has a slight disadvantage in that the drive mechanism 18 extends forwardly of the support mechanism 16 thus preventing the latter from being positioned contiguous with the table. A second embodiment of the surgical support designated 10' is shown in FIGS. 4 and 5 where the drive mechanism 18' is positioned rearwardly on frame 12 relative to its position in the embodiment shown in FIGS. 1-3. In order to accommodate drive mechanism 18' in this position, the forward portion 68' of fairing 22' has a recess 200 on which the drive mechanism 18' is situated.

As the only substantial modification in the surgical support of the second embodiment relative to the one shown in FIGS. 1-3 is in the drive mechanism 18', it may be assumed that the support shown in FIGS. 5 and 5 is identical in all other respects to the first disclosed

embodiment. The drive mechanism 18' comprises a cylindrical housing 202 having a lower section 204 journaled in a bearing 206 mounted in frame 12. The drive motor, sprocket transmission, and drive wheel are disposed within housing 202 in an identical manner as before. Positioned over housing 202 in telescoping relationship with it is a tubular member 208 whose upper end is rotatably journaled in a bearing 210 fixed to fairing 22'. The tubular member 208 is movable longitudinally with respect to housing 202 so that when support mechanism 16' is raised, tubular member 208 ascends with it. However housing 202 is rotatably fixed to tubular member 208 by a pin 212 fixed to housing 202 which extends through a vertical slot 214 formed in tubular member 208. Thus, tubular member 208 may be raised but not rotated relative to housing 202. Channels 216 (analogous to channels 78 in the first embodiment) are mounted on opposite sides of tubular member 208. These channels have key slots 218 similar to slots 80 which receive arms 220 on which are mounted foot supports 222. Two sets of microswitches 224 and 226 are provided on the outside and inside edges respectively of the foot supports whose functions are analogous to the pairs of microswitches 116 and 138.

In operation, the position of the foot supports 222 on each channel is determined prior to the commencement of the operation. During the operation, if the support mechanism 16' is desired to be raised, the microswitch 224 on, for example, the left foot support is activated by the surgeon's foot. Correspondingly, should it be desired to lower the support mechanism, the microswitch 224 on the right foot support is activated. It is clear from the foregoing that when the support mechanism is raised, the tubular member ascends with fairing 22' thereby raising the foot supports as a unit together with the support mechanism 16'. By activating the appropriate one of microswitches 226, the surgical support 10' may be propelled toward or away from the operating table. To steer the support 10', appropriate pressure is exerted by the surgeon on the foot supports to rotate tubular member 208 which causes housing 202 to rotate thereby directing the steering and drive wheel 102' in the desired direction.

It has been found to be impractical to transport the surgical support through hallways, onto elevators, etc., by "driving" it as described above in relation to positioning the surgeon relative to the operating table during the operation. This is due to the fact that the motor 106 provides a large gear reduction whereby the support can only be drawn slowly. To assist in the transport of the surgical support, it is advantageous to lift the drive wheel 102 from the ground. This may be accomplished using the apparatus shown in FIG. 6 which includes a frame 150 adapted to fit over a lip 152 provided on the front of the support. The frame is secured to the lip 152 by screw 151. A wheel 154 is rotatably mounted on a threaded shaft 156 which is received in a threaded bore formed in a flange 158 extending from frame 150. When it is desired to move the surgical support a substantial distance, frame 150 is slipped over lip 152 and secured by screw 151. Shaft 156 is then rotated until wheel 154 contacts the ground and further rotated until drive wheel 102 is raised. The support is then ready to be transported.

Obviously, numerous modifications and variations are possible in light of the above disclosure. It is there-

fore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described herein. For example, the foot operated microswitches may be placed in another location (such as in the yoke) other than as specifically shown. Also, other configurations for the arm and foot supports are possible.

What is claimed is:

1. A support for use by a surgeon during a surgical operation comprising:

a frame mounted on wheels;

means positioned on said frame for supporting the body and limbs of said surgeon, said supporting means including a mounting assembly located over said frame, a seat fastened to said mounting assembly, a pair of foot supports fixed to said mounting assembly, means for positioning said foot supports at any one of a plurality of desired positions on said mounting assembly, a pair of arm supports fixed to said mounting assembly, means for adjusting the position of said arm supports on said mounting assembly, the positions of said seat, foot supports and arm supports relative to each being adjustable;

means for moving said mounting assembly in the vertical direction relative to said frame so that said seat, foot supports and arm supports are moved together as a unit; and

a source of power for driving at least one of said wheels, means for controlling the direction of rotation of said at least one of said wheels, and means for steering at least one of said wheels.

2. A surgical support as recited in claim 1 wherein said means for controlling the direction of rotation of said wheel includes a housing mounted on said frame, a control arm pivotally mounted within and extending partially outside said housing, and switch means provided within said housing including means for activating said switch means in one mode when said control arm is pivotted in one direction and means for activating said switch means in another mode when said control arm is pivotted in the other direction.

3. A surgical support as recited in claim 1 wherein said steering means includes a housing comprising a cylindrical portion rotatably mounted on said frame, said at least one of said wheels being mounted in said housing cylindrical portion, and handle means for rotating said housing thereby steering said wheel.

4. A surgical support as recited in claim 1 wherein said means for moving said mounting assembly includes a screw element rotatably mounted on said frame, a carriage member threadedly cooperating with said screw element, means rigidly fastening said carriage member to said mounting assembly, and means for rotating said screw element.

5. A surgical support as recited in claim 4 wherein said means for rotating said screw element includes a reversible motor, a source of power for driving said motor, and a pair of switch means associated with each foot support for activating said motor in a particular direction.

6. A surgical support as recited in claim 1 wherein said mounting assembly comprises a first mounting member, said seat and said foot supports being mounted on said first mounting member, and a second mounting member rigidly attached to and extending upwardly from said first mounting member, said arm

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supports being mounted on said second mounting member.

7. A support for use by a surgeon during a surgical operation comprising:
a frame;

means positioned on said frame for supporting the body and arms of said surgeon, said supporting means including a mounting assembly located over said frame, a seat fastened to said mounting assembly, a pair of arm supports fixed to said mounting assembly, means for adjusting the position of said arm supports on said mounting assembly, the positions of said seat and arm supports relative to each other being adjustable;

adjustable drive means for propelling said support along the ground in a particular desired direction; means journaled to said mounting assembly and slidably associated with said drive means for mounting

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a pair of foot supports thereon;

a pair of foot supports mounted to said foot support mounting means at one of a plurality of positions; means for moving said mounting assembly in the vertical direction relative to said frame so that said seat, foot supports and arm supports are moved together as a unit.

8. A support as recited in claim 7 wherein said foot support mounting means are telescopically positioned over said drive means.

9. A foot support as recited in claim 8 wherein said foot support mounting means has a vertical slot formed therein and said drive means has a pin fixed thereon which extends through said slot so that said foot support mounting means is movable in the vertical direction relative to said drive means and is fixed thereto upon rotation.

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